

AD-A032 068

ARMY TRAINING AND DOCTRINE COMMAND FORT MONROE VA
JOINT SERVICE OPERATIONAL REQUIREMENT (JSQR) FOR THE POSITION L--ETC(U)
SEP 76

F/G 17/2

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DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
FORT MONROE, VIRGINIA 23651

AD A032068

ATCD-SC-S

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22 Sep 1976

SUBJECT: Joint Service Operational Requirement (JSOR) for the Position Location Reporting System (PLRS).

SEE DISTRIBUTION

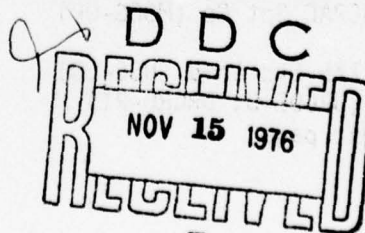
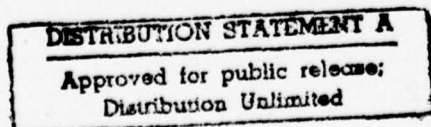
1. References.

- a. DODD 5000.1.
- b. DODD 5000.3.
- c. DODD 4100.35.
- d. AR 1000-1.
- e. AR 71-9.
- f. Letter, ATCD-SC-I, HQ TRADOC, 15 April 1975, Letter of Agreement (LOA) for PLRS.
- g. USMC/USA Memorandum of Agreement on the Joint Management of PLRS, 8 March 1976.

2. HQDA approved subject JSOR on 6 August 1976. The following information is applicable to this document:

a. System Designation: Non-major requiring HQDA In-Process Review (IPR) approval. HQDA will review this designation as the program progresses to determine if consideration should be given to elevation of the PLRS program to major system status.

- b. Materiel Developer: USADARCOM.
- c. Combat Developer: USATRADOC.
- d. Logistician: USALEA.



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ATCD-SC-S

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SUBJECT: Joint Service Operational Requirement (JSOR) for the Position
Location Reporting System (PLRS)

e. Operational Tester: USA0TEA.

f. CARDS Reference Number: 0866.

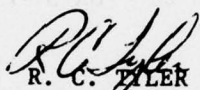
3. In compliance with reference g, this JSOR documents the requirements of the Army and Marine Corps for PLRS and, as approved, will be the basis for satisfying stated user needs.

4. Subject requirement document is forwarded to major Army commands, other services and DOD agencies for harmonization and to all other addressees for information.

5. Correlation: TRADOC Action Control Number 22941. ✓

FOR THE COMMANDER:

1 Incl
JSOR


R. C. TYLER
CPT, AGC
Assistant AG

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22 September 1976

SUBJECT: Joint Service Operational Requirement (JSOR) for the Position
Location Reporting System (PLRS)

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Chief of Naval Materiel (NMAT-0302, NMAT-00M, NMAT-03PM, NMAT-03LM)

Comdt of the Marine Corps (RD, OTOS, LMC-3)

CG

Marine Corps Dev & Educ Comd (Dev Cen)

FMF LANT

FMF PAC

1st Marine Div

2nd Marine Div

3rd Marine Div

4th Marine Div

1st MAW

2nd MAW MCAS

3rd MAW MCAS

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SUBJECT: Joint Service Operational Requirement (JSOR) for the Position
Location Reporting System (PLRS)

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USA Op Test & Eval Agcy/Concepts Anal Agcy (ATFE-LO-OT)

USAF Aero Sys Div (XRL)

USAF Tac Air Warfare Cen

TARCOM (ATFE-LO-TA)

USMC Dev & Educ Comd (ATTFE-LO-DC)

JOINT SERVICE OPERATIONAL REQUIREMENT (JSOR)
FOR THE
POSITION LOCATION REPORTING SYSTEM (PLRS)

1. STATEMENT OF THE NEED:

a. An improved system that will not be constrained by geographic location or environmental conditions is needed to provide cooperating users real-time position location and navigation information. This knowledge is required in all intensities of conflict by both Army and Marine Corps units down to platoon or patrol level.

b. A system is needed that will provide timely and accurate three-dimensional positioning information in support of the tactical command and control system of a division /corps/separate brigade/Marine Air Ground Task Force (MAGTF). Information provided by the system is needed to increase the commander's combat capability through enhancement of this ability to--

- (1) Provide reliable navigation assistance to friendly forces.
- (2) Effectively employ both fire and air support in a coordinated, timely, and accurate manner, and
- (3) Effectively control and maneuver ground elements.

c. CARDS reference number: 0866

2. TIME FRAME: The PLRS must satisfy the positioning and navigation requirements of the Army and Marine Corps during the 1980 to 1990 period. The Initial Operational Capability of the PLRS shall be in 1982.

3. THREAT/OPERATIONAL DEFICIENCY: Timely and accurate real-time positioning and navigating information is essential to the effective control of maneuver elements and to the coordinated employment of both fire and air support in a tactical environment while operating under all conditions of visibility, weather, terrain, and during night operations. The current system, which relies upon the classic technique of utilizing a map and compass and voice or data narrowband radio link to report position-location to command and control centers, does not adequately meet these requirements. This is especially true when operating during the hours of darkness and in those parts of the world which are devoid of prominent terrain features. The PLRS will correct this serious operational deficiency.

Incl

4. OPERATIONAL/ORGANIZATION CONCEPT:

a. The PLRS shall employ two categories of hardware: master units (MU) and user units (UU). The MU shall provide centralized network management and automatic processing of position, navigation, identification, and limited preassigned digital data message exchange capabilities to all co-operating users. UU's (electronic transceivers) that are functionally identical and individually identifiable to the MU will perform all transceiver, reporter and relay functions necessary for all ranging and communication operations with the MU.

b. PLRS will be deployed with two identical MU's (one primary and one alternate master unit (AMU)). The AMU will provide a displacement capability without interruption of the existing service and provide control in the event of loss of the primary MU. The Army will deploy the PLRS on the basis of one system per Army division. The Marine Corps will deploy a PLRS in support of a Marine Amphibious Brigade (MAB) operating independently or on the basis of one PLRS for each infantry regiment operating as part of a Marine Amphibious Force (MAF).

c. The PLRS UU's when controlled by a MU may be employed by all elements of the Army and/or Marine Corps. The quantities required by each service's organizational elements shall be as stated in the Army Basis of Issue Plan (BOIP) and the Marine Letter of Adoption and Procurement (LAP). Initial documentation of these quantities will be distributed separately from this JSOR.

d. Maximum size of operating crew:

(1) Master Unit: 5 men per item (4 operators, 1 supervisor).

(2) User Unit: 1 man, additional duty.

5. ESSENTIAL CHARACTERISTICS:

a. The PLRS shall be a time-division, multiple access (TDMA) system that operates in the ultra-high frequency (UHF) band and shall be capable of providing information relative to the integration functions of position-location, navigation, identification and limited preassigned digital data message exchange. Multiple access by time division can be accomplished by either technique of synchronous or asynchronous interrogate-respond modes.

b. The PLRS shall utilize encryption and spread spectrum techniques to help minimize EW vulnerability. Reduction in EW susceptibility shall be consistent with maintaining PLRS operation in the environment and under the conditions specified in a validated PLRS EW Threat.

c. The PLRS shall determine the position of a cooperating UU by making range measurements between that unit and several other UU's, whose positions are known. Each UU shall contain a small pressure transducer, which measures and reports the altitude of that unit. Trilateration or multilateration techniques, in conjunction with an altitude measurement, shall be used to provide position solution in three-dimensional space.

d. Position information derived by the PLRS shall be disseminated in either Universal Transverse Mercator (UTM) or Universal Polar Stereographic (UPS) coordinates which are correlated to geodetic coordinates.

(1) Static Base Lines: This mode is utilized when the PLRS is operated on land. Externally determined position of the three distinct reference points (in UTM or UPS coordinates) on the earth will be entered and stored in the PLRS Master Unit computer in order to correlate the PLRS grid to the geodetic grid.

(2) Dynamic Base Lines: This mode is utilized when the PLRS is operated during an amphibious operation. Because the MU and UU's are aboard ships, the base lines vary with time. Accordingly, the positions of known reference units must be continuously updated and entered into the PLRS Master Unit computer.

e. Positioning shall be enumerated by two alphabetic letters for each 100,000 meter square and eight numeric digits which will provide nearest ten meters readout capability for "false easting" and "false northing" coordinates. The algorithms used to derive coordinates for different spheroids shall be programed in such parametric form that the master unit operator can manually enter the arguments for major or minor axes of the different spheroids which are the basis for the tactical maps in the area of operation. The following spheroids shall be programed:

International, Clark 1866, Clark 1880, Everest, Bessel, Australian National, Airy, Modified Everest, Modified Airy, and the DOD World Geodetic System.

f. To achieve over-the-horizon capability, the PLRS shall employ, via the master unit, automatically controlled integral UU's employed as relays. The capability to use either surface or airborne-oriented integral relays shall be provided.

g. Typically, the PLRS shall have the capability of handling approximately 370 units, surface vehicle units, and aerial units. It shall be possible

to vary the update rates on cooperating individual user units from one update every two seconds to one update every 30 seconds as required by UU density. A typical distribution of cooperating user unit types, along with representative update period, is as follows:

	<u>Quantity</u>	<u>Update Period</u>	<u>Update Rate Units/Sec</u>
Manpack Units (MPU)	220	30 seconds	7-1/3
Surface Vehicle Units (SVU)	55	15 seconds	3-2/3
Rotary-Wing Aircraft Units (RAU)	55	5 seconds	11
Fixed-Wing Aircraft Units (FAU)	<u>40</u>	2 seconds	<u>20</u>
TOTAL	370		42

h. Relative to the limited preassigned digital data capability, a single PLRS Master Unit shall have a capability for approximately 1000 messages programed into 10 message sets, each consisting of approximately 10 pre-assigned digital messages. Each user unit shall have a capability for approximately 100 preassigned digital messages.

i. Display symbology utilized in the master unit shall be consistent with FM 21-30, Military Symbols, and FM 21-31, Topographic Symbols.

j. PLRS must be able to satisfy the following Positioning and Navigation (POS/NAV) user accuracy requirements:

(1) Horizontal Accuracy

<u>Use</u>	<u>Accuracy</u> (In Meters, Equivalent CEP)
Maneuver elements (ground and air)	20-100
Artillery positioning	20-30
Target location and surveillance	10-50

(2) Vertical accuracy requirements are $\pm 3\%$ of the altimeter reading.

k. The master unit shall be housed in a standard tactical shelter which is vehicle, helicopter and air transportable. In order to reduce physical vulnerability, the volume shall have precedence over the weight of the shelter in trade-off analyses.

l. The size and weight of all PLRS Manpack, Surface Vehicular, and Airborne User Units shall be held to a minimum, but the Manpack Unit shall not exceed 10 to 15 pounds or 300 to 500 cubic inches including user read-out and battery. This weight shall include antenna, all accessories

required for normal manpack operation and a battery power supply, sufficient for at least 24 hours of continuous operation at temperatures to minus 15°C. PLRS Airborne User Units shall be packaged to facilitate installation and maintenance in the tactical airplanes and helicopters for which they are intended.

m. Mean Time Between Failure (MTBF).

(1) Master Unit (MU).

- | | |
|--------------------------------|---------------|
| (a) Data Processing Equipment: | SV 500 hours |
| | MAV 250 hours |
| (b) Other Equipment: | SV 1000 hours |
| | MAV 500 hours |
| (c) Total MU: | SV 500 hours |
| | MAV 250 hours |

(d) The Master Unit and Alternate Master Unit are required to operate 23 hours per day. The operational cycle, which consists of actual operating time, down times and ready time, is 30 days with an operational availability of 99% for 500 hour MTBF equipment and 99.9% for 1000 hours MTBF equipment.

(2) User Unit (UU).

- (a) SV 1000 hours - MAV 500 hours.

(b) User Units are required to operate 15 hours per day. The operational availability is the same as the MU.

n. Mean Time to Repair (MTTR).

(1) Master Unit.

Organization/DS	15-20 minutes
General support	30-35 minutes
Depot	2 hr-2 hr and 15 minutes

(2) User Unit.

Organization/DS	15-20 minutes
General support	30-35 minutes
Depot	2 hr-2 hr and 15 minutes

o. Component part commonality shall be maximized between manpack units, surface vehicle units and airborne units.

p. Power sources for the PLRS shall be compatible with power sources for communications equipment in the field.

q. Nuclear survivability, with the exception of electromagnetic pulse (EMP), is not a requirement for this developmental item because a sufficient density will exist on the battlefield to allow timely replacement of damaged or destroyed equipments.

r. PLRS is to be fully crypto-secure.

s. There are no special training, camouflage or ECCM requirements for PLRS.

t. Collective Protective Equipment (CPE) is not a requirement.

u. The system must provide for prevention of enemy use in the event user equipment is captured.

v. The Position Location Reporting System (PLRS) shall withstand air, highway, rail, and water transport without damage. Transportability problems will be reported IAW AR 70-47.

6. TECHNICAL ASSESSMENT:

a. Required Technical Effort. The PLRS design characteristics shall include--

(1) Crypto-security.

(2) Fully automatic self-surveying capability after two intersecting base lines have been established.

(3) Automatic establishment of relay chains from one user unit to another.

(4) Provisions for users to select and be provided with grid coordinates (Easting, Northing and Altitude) or polar coordinates (range, bearing, and elevation) of predefined points.

(5) Modular construction.

(6) Capacity for each master unit to support an Army division or a Marine Amphibious Brigade (MAB).

(7) Capability for each master unit to interoperate with up to four other individual PLRS Master Unit networks.

b. Scope. From an operational viewpoint, the PLRS can be broken out into three distinct phases--

(1) Initialization Phase - that period of time when the master unit and cooperating user units are being set up to operate.

(2) Steady-State Phase - that period of time when the PLRS services are provided to cooperating user units in a timely fashion.

(3) Transition Phase - that period of time when a particular master unit is being phased out of normal operations, due to displacement of the tactical area of responsibility (TAOR), passage of lines, etc.

c. Each one of the above phases requires further technical refinement. At the present time, four specific tasks have been identified relative to the Initialization Phase and the Steady-State Phase.

(1) TASK 1: To determine if the initialization time of PLRS is functionally related to the number of cooperating users being serviced in a single PLRS network.

(2) TASK 2: To determine a plan for simulating the total system capability of a single PLRS network consisting of a single master unit which services cooperating user units that have various combinations of manpack units, surface vehicle units, airborne units and fixed relay units.

(3) TASK 3: To determine an optimum technique to inter-connect five PLRS networks.

(4) TASK 4: To determine the type and quantity of PLRS information and distribution methods to specified systems in support of the command and control system at division/corps/separate brigade/MAGTF (Interoperability/Interface):

d. Technical Approach: The Hughes Aircraft Company has been awarded a contract for Full Scale Engineering Development. The Hughes technical approach to the Engineering Development model employs a synchronous technique of time division multiple access which allows each individual user to have access to a radio channel in ordered sequence. This approach is characterized by automatic synchronization of User Units to perform pre-programed functions under the control of the Master Unit.

e. Associated Risks.

(1) There is a low technical risk associated with achieving minimum position location error at 100 NM ranges due to the utilization of integral relays.

(2) There is moderate technical risk relative to achieving the EW protection that will be required under operational conditions and a standard threat scenario. Spread-spectrum technology does achieve good EW protection;

however, the amount of bandwidth allocated for the PLRS (30 Megahertz total) may not be sufficient. If this is the case, more bandwidth may have to be allocated. There will be a low technical risk if the additional bandwidth is provided. The PLRS must be electro-magnetic compatible with other systems in the frequency band selected for its operation. An electro-magnetic compatibility (EMC) analysis shall be conducted prior to any procurement decision.

(3) It is a PLRS design objective to develop a truly low-cost manpack unit. There is a low technical risk that a manpack unit can be developed that will have an average unit production cost of \$10K to \$12K if Design-to-Unit-Production Cost (DTUPC) criteria is adhered to.

(4) For Army applications, the PLRS must be highly adaptive to both geographical area and the size of the force to be supported. There is a low technical risk associated with developing an optimum base line technique that will allow one PLRS network to interoperate with up to four other PLRS networks to support an Army corps.

7. LOGISTIC ASSESSMENT.

a. The Integrated Logistics Support elements for the PLRS shall include the maintenance concept/plan, support and test equipment, repair parts and other supply support, transportation and handling, technical data, facilities, and personnel and training. The basic requirements for each of the support elements shall be further refined during the engineering development phase.

b. The maintenance concept for the PLRS shall stress user self-sufficiency with organizational level maintenance performed at the equipment location. Organization level maintenance of User Units shall consist of routine scheduled maintenance tasks such as preventive maintenance. Unscheduled Master Unit maintenance tasks shall consist of fault isolation to the replaceable unit or functional card group and repair by replacement of the defective unit or functional card group. Fault correction verification shall be accomplished by use of computer diagnostics and built-in test equipment.

c. As now envisioned, the deployment of the PLRS will not change current and projected pertinent supply, maintenance, and transportation systems and procedures. Maintenance float support is proposed for user units.

d. The Department of the Army, as lead service, is responsible for materiel acquisition (DODD 5000.1 and DODD 5000.3) and integrated logistic support planning (DODD 4100.35) for the PLRS.

8. TRAINING ASSESSMENT:

a. The basic requirements for training shall be further refined during the engineering development phase. As now envisioned, the training philosophy used for the PLRS is to provide students with a working knowledge of the theory of operation and maintenance features of the system. The training courses shall be conducted in accordance with approved training course plans

and use instructor teams (two instructors per team) specializing whenever possible on specific course items. These courses are to provide early training for operation and support (O&S) personnel and key technical personnel that will be employed during DT/OT II.

b. A training package of effective and practical instructional media including Improved Technical Documentation, Training Extension Course Lessons, devices, and literature suitable for introductory and continuing use at both unit and institution will be provided by the Materiel Developer and be available at system IOC date.

9. LIFE CYCLE COST ESTIMATE.

a. These costs are based on a BCE which was validated on 17 June 76 by ECOM Cost Estimate Control Data Center (CECDC). The R&D portion of the BCE was modified as a result of a PLRS General Officer Review which was convened by HQ DA on 11 Jun 76. Accordingly, the R&D costs represent a "development estimate" as defined on page 5 of the AMC Guide, dated Dec 1974, entitled: Design To Unit Production Cost.

b. Summary of estimated life cycle costs as expressed in constant and inflated FY-76 dollars (\$M-Millions).

	CONSTANT DOLLARS		INFLATED DOLLARS	
	<u>Most Likely</u>	<u>High</u>	<u>Most Likely</u>	<u>High</u>
R&D				
Army	13.401	15.591	16.213	18.863
Marine Corps	7.598	8.839	8.651	10.064
Total	<u>20.999</u>	<u>24.430</u>	<u>24.864</u>	<u>28.927</u>
Investment				
Army	214.552	TBD*	TBD*	TBD*
Marine Corps	88.914	TBD	TBD	TBD
Total	<u>303.466</u>	<u>TBD</u>	<u>TBD</u>	<u>TBD</u>
O&S (10 years)				
Army	164.300	TBD	TBD	TBD
Marine Corps	72.100	TBD	TBD	TBD
Total	<u>236.400</u>	<u>TBD</u>	<u>TBD</u>	<u>TBD</u>
Summary				
R&D	20.999	24.430	24.864	28.927
Investment	303.466	TBD	TBD	TBD
O&S	236.400	TBD	TBD	TBD
Total	<u>560.865</u>	<u>TBD</u>	<u>TBD</u>	<u>TBD</u>

*TBD = To Be Determined

c. Procurement Quantities.

<u>R&D</u>	MU	C2S(1)	MPU	SVU	AU
Quantities	2	1	44	10	10

Note 1: Command and Control Shelter is not part of the PLRS and is being procured to perform a CPX demonstration.

<u>Investment</u>	MU	MPU	SVU	AU
Army (2)	44	4138	1728	2707
Marine Corps (3)	20	2117	508	871
Total	64	6255	2236	3578

Note 2: Army quantities represent a 16 division force, 4 corps headquarters, 4 service schools and 15% float.

Note 3: Marine Corps quantities represent a 3 division force, training needs and 15% float.

d. R&D sunk costs (in then year dollars) for the period FY-63 to FY-76 are (\$M-Millions):

(1) Army	3.930
(2) Marine Corps	12.525
(3) Total	16.455

e. Quantity/unit costs expressed in constant FY-76 dollars for first production run (\$K-thousands).

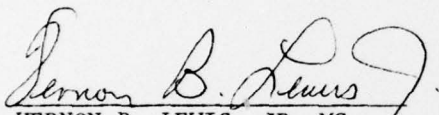
<u>ITEM</u>	<u>QTY</u>	<u>DTUPC</u>	<u>UNIT FLYAWAY</u>	<u>UNIT PROCUREMENT</u>
MU.....		500(4)	1,073.6	1,382.5*
Army	16			
Marine Corps	6			
Total	22			
MPU.....		11	14.0	18.1*
Army	1371			
Marine Corps	1229			
Total	2600			
SVU.....		13	16.9	21.8*
Army	600			
Marine Corps	300			
Total	900			
AU.....		15	19.5	25.0*
Army	803			
Marine Corps	497			
Total	1300			

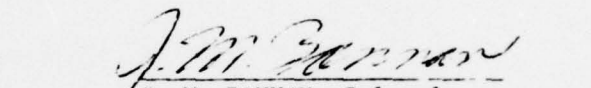
Note 4: Master Unit DTUPC does not include cost of GFE. The esimated total cost of Master Unit is \$898K.

f. Recommended funding profile expressed in constant FY-76 dollars and inflated dollars (\$M-Millions).

<u>RDTE</u> (FY-76\$)	FY-76	FY-77	FY-78	FY-79	TOTAL
Army	0	1.309	1.984	2.900	13.401
Marine Corps	<u>1.793</u>	<u>.918</u>	<u>2.629</u>	<u>1.560</u>	<u>7.598</u>
Total	1.793	2.227	4.613	3.598	20.999
Composite Index (FY-76\$)					
Value	1.031	1.092	1.141	1.218	1.290
Inflated Totals					
Army	0	1.430	2.263	3.741	16.213
Marine Corps	<u>1.849</u>	<u>1.002</u>	<u>3.000</u>	<u>1.900</u>	<u>8.651</u>
Total	1.849	2.432	5.263	4.641	24.864

*Non-recurring Investment prorated over first procurement run.


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 ODCSOPS
 Department of the Army


 J. M. BANNAN, Colonel
 (Acting) Deputy Chief of Staff Research,
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 United States Marine Corps